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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/895,213	07/02/2001	Shigeo Yoshii	0819-0592	8545

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EXAMINER

MONDT, JOHANNES P

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 03/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/895,213

Applicant(s)

YOSHII ET AL.

Examiner

Johannes P Mondt

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 December 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 2-11 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 12-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Amendment B filed 12/12/2002 and entered as Paper No. 12 forms the basis of this office action. In Amendment B Applicant substantially amended claim 1 and added new claims 12-22. Therefore, claims 1 and 12-22 are taken into consideration at this time, claims 2-11 having been withdrawn in Paper No. 9. Comments on Remarks in Amendment B are included below under "Response to Arguments".

Response to Arguments

Amendment B has substantially amended all pending claim language through substantial amendment of claim 1 and has substantially amended the specification and has thereby overcome the rejection under U.S.C. 112 of claim 1 and the objection to the specification. Furthermore, Figures 17-20 marked "Prior Art" have been located in the file. The substantial amendment of claim 1 in Amendment B overcomes the rejection under U.S.C. 103(a) of claim 1 but only because the composition of the graded layer near the GaAs active layer is characterized by $x=0.18$ in Fujii, which can be read as "nearly" equal to zero, its value for the active layer 48, however, said composition near the active layer is not equal to zero (as required by the amended version of the claim). However, a modification of the teachings of the Prior Art as Admitted by Applicant and Fujii et al to include the amended portion of claim 1 is obvious over Duggan, who teach the insertion of graded layers between the active layer and the otherwise adjacent

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doped (cladding) layers for the specific purpose "to lattice match said graded layers on each side with the result that the strain at the interfaces between the layers is reduced and the possibility of deleterious dislocations being introduced at the interfaces is minimized". The teaching by Duggan, when applied to the combined teachings of the Prior Art as Admitted by Applicant and Fujii et al, is possible if and only if the value of the composition parameter of the graded layer 46 at the interface between 46 and 48 (the active layer) be modified from 0.18 to 0.0, because the lattice parameter is a monotonic and continuous function of the aforementioned composition parameter.

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. **Claims 14-15 and 20-22** are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. In particular, with regard to claim 14, none of the Figure renditions pertaining to the elected embodiment, nor the text on said embodiment, discloses an "electrode interposed between the graded composition layer and the active layer". Claims 15 and 20-22 are included in this rejection due to their dependence on claim 14.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. ***Claims 1, 12-13 and 16-19*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Prior Art as Admitted by Applicant in view of Fujii et al (5,476,811) and Duggan (6,072,189).

With regard to claim 1: Applicant admits as Prior Art (cf. page 2, line 20 – page 3, line 13 and Figure 17):

A semiconductor light-emitting device comprising: first (902) and second (905) semiconductor layers each of a first conductivity type; a third semiconductor layer (903) of a second conductivity type provided between the first and second semiconductor layers; an active layer (904) provided between the second and third semiconductor layers, the active layer emitting light with charge injected therein from the second and third semiconductor layers (inherently the respective functions of the active layer, and of the emitter and base layers).

Prior Art as admitted by Applicant does not necessarily teach a graded composition layer provided between the active layer and the third semiconductor layer to have a varying composition which is nearly equal to a composition of the active layer at an interface with the active layer and to a composition of the third semiconductor

layer at an interface with the third semiconductor layer. However, as witnessed by Fujii et al (cf. Figures 3 and 4), the use of a graded composition layer (46) (cf. column 7, lines 28-31) abutting the active layer (48) (cf. column 7, lines 33-34) such that the composition of the graded composition layer is nearly equal to the composition of the active layer at the interface with said active layer and such that the composition of the graded composition layer is equal to a composition of a doped semiconductor layer of second conductivity type (44) (cf. column 7, line 14) abutting said graded composition layer at the interface with said doped semiconductor layer abutting said graded composition layer has long been standard in the field of semiconductor light-emitting devices. As shown in Figure 4, inter alia the valence band energy varies gradually between (48) and (44) (cf. column 7, lines 59-67).

Motivation for including the teaching by Fujii et al in this regard in the Prior Art as admitted by Applicant is the possibility to construct a light-emitting device with low current threshold (cf. column 2, lines 1-14 in Fujii et al for this teaching). The inventions can be *combined* by epitaxial formation of a graded composition layer (cf. for instance title and abstract in Fujii et al). *Success* in the implementation of this combination can therefore be *reasonably expected*.

Neither Prior Art as Admitted by Applicant nor Fujii et al necessarily teach the graded composition layer to have a composition at the interface with the active layer that is equal to the composition of the active layer at said interface. However, it would have been obvious to one of ordinary skills in the art to modify the invention by the Prior Art as Admitted by Applicant and Fujii et al to include this teaching because of a patent

to Duggan on inter alia semiconductor light-emitting devices (hence the art of the invention and of the prior art cited above), in which on each side of the active layer a graded layer is inserted between the active layer and the cladding layer such that the "constituency of each graded layer is graded from one side to the other side of the layer such that the layer is lattice matched with the adjacent layer on each side, with the result that the strain at the interfaces between the layers is reduced and the possibility of deleterious dislocations being introduced at the interfaces is minimized" (cf. abstract). See Figure 7 and graded layers 41, 42, 43, and 44; cladding layers 4 and 6; and active layer 5 (cf. column 7, lines 55-68 and column 8, lines 1-5). Because of the dependence of the lattice constant on the composition parameter x one and only one possibility is available to achieve this exact matching of the lattice also at the interface between the active layer and the graded layer, i.e., $x=0$, i.e., the composition of the graded layer is equal to the composition of the active layer at the interface between active layer and graded layer.

Motivation to include the teaching is in this regard is the desirability to avoid the deleterious effects of dislocations on light output. *Combination* of the teaching is readily achieved by extending the decrease in x from 0.18 to 0.0. Therefore, *success* in the implementation of the combination can therefore be *reasonably expected*.

With regard to claim 12: the composition at the grade composition layer varies continuously (cf. Fujii et al, column 7, lines 17-37).

With regard to claim 13: The further limitation of claim 13 is not necessarily taught by the cited references. However, step-wise varying composition of the graded

layer without delineation of the size of the step is infinitesimally close to a continuously graded layer, because a continuously graded layer is structurally equivalent to a stepwise graded layer in which the step size is taken to the zero limit (simultaneously the number of steps going to infinity). Therefore, the range of the step being left unspecified in the present claim language, the range for the step implied by this claim is infinitesimally close to the one essentially taught in the prior art. Applicant is reminded that a prima facie case of obviousness typically exists when the range typifying a claimed composition overlap the ranges disclosed in the prior art or, as pertains in the underlying case, when the range typifying a claimed composition does not overlap but is close enough such that one skilled in the art would have expected them to have the same properties. In re Peterson, 65 USPQ2d 1379 (CA FC 2003).

With regard to claim 16: the examiner takes official notice that the further limitation of this claim that a forward bias voltage is applied between the third and second semiconductor layer during the light-emitting period is inherent in the functioning of a semiconductor light-emitting device, because light is emitted as electrons and holes recombine when propelled in opposite directions due to the application of a forward bias voltage, while the further limitation that the third semiconductor layer and the first semiconductor layer is adjusted to zero (except for a minute ohmic voltage drop inherently present along any current path) is inherent in the commonality of the conductivity types of said third and first semiconductor layers.

With regard to claim 17: the examiner takes official notice that the further limitation of claim 17 is inherent in the conventional way of operation of semiconductor

light-emitting devices: said reverse bias stops the inflow of charge carriers in the active layer and thereby the production of recombination-produced light.

With regard to claims 18-19: Applicant's specification does not show why either of the conductivity type selections for the third semiconductor layer is critical to the invention. In the art of semiconductor devices it is understood that where the general conditions of the semiconductor device are found in the prior art a mere interchange of conductivity types of all semiconductor layers and regions does not carry any patentable weight unless a particular selection is shown in the specification to be critical to the invention. In the present case, the Prior Art as Admitted by Applicant teaches the third semiconductor layer to be of n-type (n-base layer 903), but both n-type and p-type evidently are taught in view of the present claims, while no strong preference can be justified based on the specification for the p-type conductivity of the base layer. Therefore, the further limitations of claims 18 and 19 do not distinguish over the prior art.

Conclusion

3. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within

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TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM
March 2, 2003

NATHAN J. FLYNN
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